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# The Scottish Runrig Fields in Satellite Images

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## Abstract

Similar systems for agriculture were the solution found by people who lived in different parts of the world to the problems of their food productions. Here we discuss and compare the runrig fields of Scottish islands to the waru-warú fields of South America. Both are long strips of cultivated raised beds separated by uncultivated canals. Both systems, runrig and waru-warú, are visible in satellite images. Then, it is possible to use the Google Earth virtual globe to investigate features and extensions of these old cultivations. Keywords: Raised fields, Runrig, Waru-warú, Agriculture, Environment, Microclimate, Archaeometry, Satellite Images, Google Earth, GIS.

## Introduction

Runrig was a system of agriculture used in the northern part of Great Britain, especially in the lands of Scotland. The name describes the fact that the fields, which appear as covered by a pattern of stripes, had been created by alternating "runs" and "rigs". The "rig" was a raised strip of cultivated land, separated from the next by a "run", which was left uncultivated [1]. In Hebrides, we have a few examples of this system, which continues to be used [1]. Besides the specific technique of cultivation based on raised beds, the runrig had a communal tenure system to manage work and production.

The runrig agriculture is similar to that of the raised fields of the Andean highlands of South America, also known as waru-warú in the Quechua language [2,3]. Both systems, runrig and waru-warú, were used for potato cultivation [4], because the microclimate created by raised beds and canals is in both cases appropriate for this plant [4]. Therefore, as we will see in the following discussion, we have two similar systems for agriculture that are answering in the same manner to the environmental problems of these two distant regions of the world.

Waru-warú and runrig fields are visible in satellite images. It means that the runrig system, like waru-warú system, can be studied by means of a geographical information program like Google Earth. This virtual planet can be a useful tool for such archaeometric investigations, because through its images, features and extensions of lands used for old cultivations can be easily evaluated.

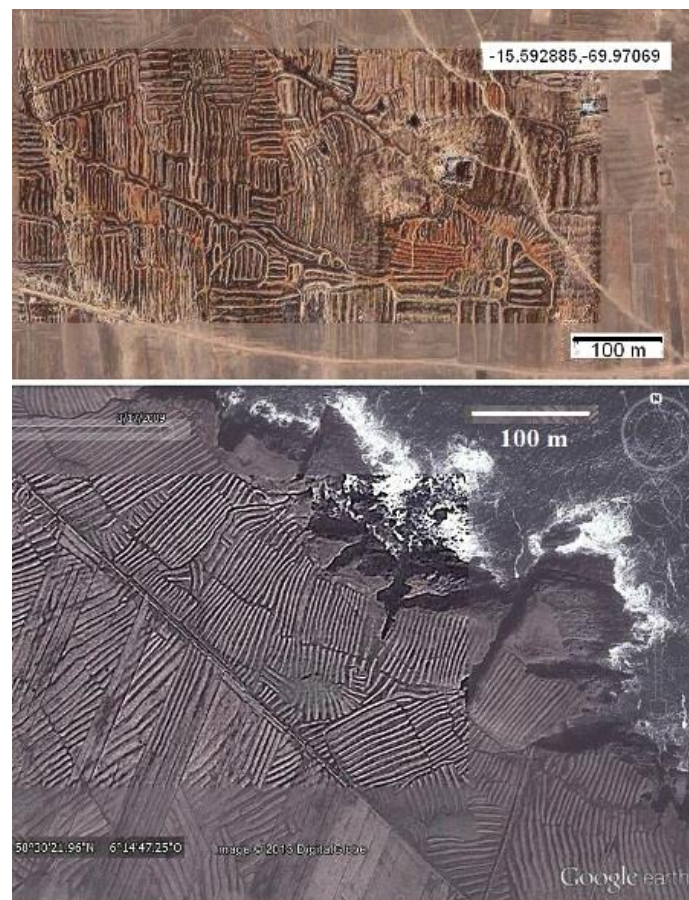
## Runrig and waru-warú

As told in [1], runrig agriculture has a great historical importance. It was the communal tenure system of farming in Scotland up to the 18th century, when the pressure toward the use of lands for grazing purposes cancelled it. In fact, this system for agriculture was used before the Highland Clearances, forced displacements from traditional land tenancies in Scottish Highlands, suffered by a significant number of people during the 18th and 19th centuries [5,6]. A few crofting communities in the Hebrides continued this runrig agriculture into the 20th century, and there are still some farmers using this method for their cultivations [1].

In runrig agriculture, the tenants had a few rigs under their tenure, and their job was to fertilise the soil using dung from animals. "Ploughing, planting and reaping, the farmer cultivated and cared for the land to produce crops to feed the family, and hopefully have some left over to barter with. It is quite likely that the tenants worked collectively with the rigs" [1]. Runrig then was a "bottom-up" organization of agriculture, like the system of raised fields in South America probably was [3] (in the Figure 1, the reader can see waru-warú in Peru, near the Lake Titicaca, compared to raised beds of the Isle of Lewis, Scotland).

In [7], an interesting anthropological paper is discussing the organization of ancient intensive farming, comparing "top-down" and "bottom-up" perspectives. The "top-down" approach is that considering the development of intensive

farming with social organization attributed to the rule action of a centralized government. On the other hand, the "bottom-up" approach is viewing intensive farming as the incremental work of local communities. For the raised fields of Titicaca, both "top-down" and "bottom-up" interpretations have been proposed [2,8,9]. In the case of runrig, this was clearly a "bottom-up" system.



**Figure 1: In the upper panel we can see waru-warú fields near Puno, Peru, close to Lake Titicaca. In the lower panel, we have the runrig fields of the Isle of Lewis, the largest island of Hebrides, Scotland. The images from Google Earth have the central part enhanced with image processing.**

Let us continue our reading of Reference 1. It is told there that every few years runrig fields were reallocated to tenants, "so no one person had a better strip of land or was deemed to be better or worse off in the long term". But this is the ideal perspective of runrig agricultural method: it seems that quarrels and misunderstandings between men were incessant, as told in "The Social Life of Scotland in the Eighteenth Century", a book written in 1901 by H.G. Graham [1,10]. This book describes the runrig fields as composed by ridges that "were usually 20 feet wide, crooked like a prolonged S and very high. Only the crown of the rig was ploughed and half the width between them was taken up by huge "baulks" or open spaces filled with briars, nettles, stones and water" [1,10]. About these words, the author of [1], Elizabeth McQuillan, observes correctly that the "high rigs would serve as a basic method of water drainage for the crop, given one might expect a lot of rain in Scotland. The "baulks" would have offered some shelter from the buffeting wind and a rich habitat for beneficial insects and birds. In the absence of chemical pesticides, these guys probably did a good job of eating many of the pests that would damage a crop".

This very interesting observation is a proper preamble to our comparison between runrig and waru-warú [4]. The waru-warú technology was a modification of the soil surface that the Andean people developed before the rise of the Inca Empire. This agricultural method combined an improvement of soil, a management of water, an optimization of the received radiant energy and a mitigation of frost [11-14]. As we can see in the satellite images of the lands near the Lake Titicaca, this agriculture created a huge network of earthworks, with embankments and canals. The embankments served as raised beds for cultivation of crops, while the canals were used for water drainage and storage to irrigate the plants. In [12-14], it was proposed that in planning the network of canals, some symbolic elements had been included, rendering these earthworks a sort of huge geoglyphs. In many cases, what we see in the satellite images does not

correspond to an agricultural activity currently in use, but is showing the remains of past activities. Therefore, it can happen to see the ghost images of waru-warú fields under the modern cultivations.

Today, this Andean agricultural technique is studied and its use suggested because it is a kind of environmentally friendly farming [4]. As previously told, waru-warú cultivation takes place in the soil of raised beds created by the construction of embankments. Within these beds, the new soil has an increased porosity, which allows an enhanced infiltration. The infiltration is 80% to 100% that of the original soil [4]. This agricultural system is recycling nutrients, chemical and biological, necessary for crop production. The raised beds receive their water through diffusion and capillary movements from the surrounding canals [4]. Therefore, the soil is kept at an adequate moisture level to facilitate the cultivation of plants such as potatoes and quinoa [4]. Because of the enhanced moisture level, thermal energy is captured and retained by the raised beds and the plants are protected from the effects of frost. As remarked in [4], the waru-warú system acts as a thermal regulation of the microclimate of these fields.



**Figure 2: Other examples of runrig. In the upper panel we can see this ancient system visible under the modern agricultural activity. In the lower panel, we have runrig over a promontory near Port of Ness, Isle of Lewis (Courtesy: Google Earth). In this case, it seems that a sort of artistic intent had been added in creating these earthworks.**

### Lazy beds and potatoes

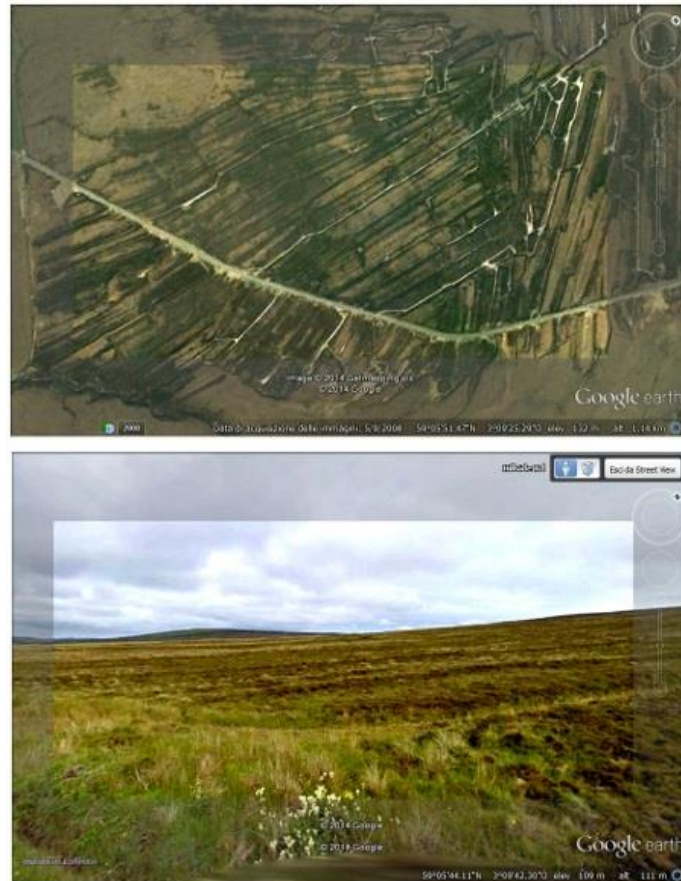
In Figures 1 and 2 we can see some runrig fields of the Isle of Lewis, Hebrides. Plentiful evidence of runrig land use can be achieved with Google Earth, throughout the whole of these islands. In some cases, when available, it is also possible to see these strips in the images of Street View. However, it is necessary to consider that other manners of using the land existed. In fact, the evolution of the systems for agriculture in the Hebrides throughout the centuries was rather complex [15-17], and it seems that the runrig system replaced an earlier system of enclosure which could have embodied a different system of landholding “and not just a different way of farming the land” [15]. Recent studies and field researches suggest that the earlier pattern of settlement was on a more individual and differentiated basis.

The raised beds are also known as lazy beds. The Old Statistical Account (OSA) of 1794 [18] describes them as having “straight, circular, serpentine, or zig-zag direction, round the intervening rocks, pools, or bogs”. The OSA gives also the description of the local society as “a little commonwealth of villagers”, whose houses were close together and



whose lands were yearly divided by lot for tillage, while their cattle grazed on the pastures in common [15,18]. In fact, this agriculture was very labour-intensive and relied largely on hand tools [15].

In Wikipedia [19], the item on lazy beds tells that to them, normally, a desalinated seaweed fertiliser was applied to improve the ground, and that potatoes were often grown in these fields until a potato blight (*Phytophthora infestans*) caused the potato famine in the Highlands. The lazy beds are reported for potato cultivation in several old texts too [20-22]. Therefore, we have that both runrig and waru-waru were used for potatoes; this is not surprising because potatoes grow in well-drained soils, since they dislike soggy soil. “Because they do all their growing underground, they can expand more easily in loose, loamy soil than in heavy, compacted, clay soil that keeps plant roots from getting the air and water they need” [23]. Runrig and waru-waru are answering in the same manner to the same environmental problems connected with potato cultivation.



**Figure 3: Fields in the central part of Mainland, Orkney Islands, in a satellite image and in Street View (Courtesy: Google Earth).**



**Figure 4: Runrig of Foula, Shetland Islands (Courtesy: Google Earth).**

## Discussion

By means of Google Earth, we see that runrig fields were used in Hebrides, even on the small islands. One example is Loch Roag, a small island totally covered by the lines of runrig agriculture. This island was cleared of its inhabitants in 1841 and is now only used for grazing. Also in Orkney and Shetland Islands we have interesting agricultural patterns. In Figure 3 we have the fields separated by canals in the central part of Mainland, Orkney Islands, viewed by the satellite and in the Street View. And in Figure 4, we see fields of Foula in the Shetland Islands. The agriculture in Orkney and Shetland Islands is discussed in [24,25].

As previously told, runrig agriculture was very labour-intensive. It means that the lands, that we see covered by the texture of these old fields, were quite populated. Famine and clearance moved people towards towns and America. The Wikipedia items [5,26] help us to understand: these items explain that landlords cleared lands to establish sheep grazing and people were relocated to poor crofts or sent to small farms in coastal areas. And in fact, we have runrig fields more visible and apparently more recent in satellite images of lands near the coast.

Clearance and potato blight originated the Highland Potato Famine, because people were very dependent on potatoes. Due to the environmental conditions, potato was the only crop able to provide enough food from such lands. Let us consider again the comparison to the raised fields and terrace hills of South America: they were labour-intensive too. The remains of this Andean agriculture are covering a huge extension of land near the Lake Titicaca, as the satellites are showing. This fact tells us that these regions were densely populated in the past, but diseases from Europe and wars depopulated them. For the Andean and Scottish Highlands, the satellite images of Google Earth are a sort of snapshot of the past.

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